of these animals. Cattle numbers, on the other hand, have ranged between 25,000 and 75,000, but with no particular pattern, and the numbers in recent years are no higher than those 100 years ago. Inventories of mules peaked in the 1940's at around 50,000, but they, along with horses and sheep, have become an insignificant part of the total in the past two decades. Thus, the overall pattern of change in large farm animals inventory in the Neuse basin during the past century is dominated by the doubling in swine numbers (Stanley 1988a).

Poultry numbers in the Neuse basin have increased dramatically in the past two decades. The total poultry inventory (broilers, chickens and turkeys) grew slowly from around 0.4 million in 1880 to approximately 1.6 million in 1960. Since then, however, poultry inventories have increased at an amazing rate, so that by 1985 there were over 8 million.

The estimated sewered population in the Neuse basin has increased steadily over the past century to 440,000 in 1985 (Stanley 1988a). Most of these people live in the upper half of the watershed, particularly in the Durham-Raleigh area. Conventional secondary treatment removes little phosphorus and only about 25-45% of the nitrogen (Gakstatter et al. 1978). When these treatment efficiencies are combined with historical data on the types of treatment practiced by municipal plants in the Neuse basin, it becomes clear that before 1950 there was no significant N or P removal from wastewater discharged into the river. As secondary treatment came into widespread use in the 1950's and 1960's in the Neuse basin, the overall nutrient removal efficiencies increased, but there has been little additional improvement in the last 10 years because further increases in treatment efficiencies have not occurred. Consequently, even now only about 27% of the Neuse basin total point source nitrogen and less than 2% of the total point source phosphorus are removed by treatment.

Total annual phosphorus loading from all Neuse basin sources (point and nonpoint) is estimated to have increased about 60% over the past century, from 1.04 million kg/year in 1880 to 1.7 million kg/year in 1985 (Figure III-14). Most of that increase has occurred during the past 40 years and it appears to be due primarily to increases in point source phosphorus (i.e., increases in sewered population). In 1880, point sources accounted for only about 2% of the total load, compared to 42% from forests, 24% from cropland, 12% from farm animals, 18% from idle cropland and 2% from pastures. In 1985 the point source phosphorus was 30% of the total. The farm animal contribution also has increased, from 0.13 million kg/year in 1880 to 0.25 million kg/year in 1985. Phosphorus from the other sources (cropland, forests, idle cropland and pastures) has not increased significantly, which is no surprise since the acreages of these land use types have not increased.

Total annual nitrogen loading is estimated to have increased 70% during the past 100 years; from 4.6 million kg/year in 1880 to 7.8 million kg/year in 1985 (Figure III-15). Like phosphorus, the rate of increase in nitrogen loading has not been constant. The loading increased until the mid 1950's, then declined slightly before increasing rapidly in the 1970's and 1980's. This pattern can be explained partly by improvements in nitrogen removal at waste treatment plants in the 1950's and 1960's, which tended to slow increases in point source loading that were occurring as the sewered population grew. But with no further improvement in the nitrogen removal efficiency since the mid-1970's, the nitrogen loading began to increase sharply as population continued to increase. Another factor leading to reductions in nitrogen loading in the late 1960's was the temporary reduction in cropland acreages which reduced cropland nitrogen runoff.

Point source increases have contributed significantly to the increased nitrogen loading. In 1880 only 2.5% of the total nitrogen was from point sources, compared to 55% from croplands, 19% from forests, 14% from farm animals, and the remainder from pasturelands and idle croplands. By 1985